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Research Note

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REGENERATION OF LODGEPOLE PINE: A STUDY OF SLASH DISPOSAL AND CONE OPENING [1]

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ABSTRACT

In central Montana, two to three times as many lodgepole pine seedlings per acre were established when logging slash was piled green than when it was piled after drying for a summer. On the Lewis and Clark National Forest 22,175 seedlings per acre were established when slash was piled fresh and 10,475 when it was piled dry; the treatments yielded 7,067 and 1,967 seedlings, respectively, on the Gallatin National Forest.

Serotinous cones placed 1 foot or more above the ground did not open, whereas 40 and 83 percent of the cones placed directly on the ground opened on north and south slopes, respectively.

Studies[2] have shown that methods used to regenerate lodgepole pine (Pinus contorta Dougl.) in central Montana produce a superabundance of seedlings. As a result, noncommercial thinnings are needed to prevent the newly regenerated stands from becoming stagnated. Current regeneration practices rely primarily upon the presence of seed stored in serotinous cones in the slash following logging operations. This slash remains in place during one growing season before disposal, and thus permits cones to dry, open, and release the stored seed. Refined methods of slash disposal are needed that will provide optimum density and maintain adequate stocking.

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[1] Research reported in this paper was done at the Forestry Sciences Laboratory at Bozeman, Montana, maintained in cooperation with Montana State College.

[2] Boe, K. N. Regeneration and slash disposal in lodgepole pine clear cuttings. Northwest Sci. 30: 1-11, illus. 1956. The present study was installed by Mr. Boe, formerly forester with Intermountain Forest and Range Experiment Station, now with Pacific Southwest Forest and Range Experiment Station.

Our hypothesis was that if the slash were piled while still green, immediately after logging, fewer cones would open, fewer seed would be released, and the potential for overstocking would therefore be lessened. This report compares density and stocking of lodgepole pine seedlings in clear-cut areas where slash was piled while green, with density and stocking in areas where slash was piled after drying for one summer. The relation of height above ground and aspect (north and south) to cone opening and release of seed is also reported.

METHODS

We tested two methods of slash disposal using a randomized block design on the Langhor drainage (elevation 7,000 feet) of the Gallatin National Forest and the Deadhorse drainage (elevation 6,500 feet) of the Lewis and Clark National Forest. The treatments consisted of: (1) piling green slash before it had been subjected to summer temperatures and (2) piling slash that had dried for one summer. The slash was burned in the fall in each treatment. Using the stocked-quadrat method we counted seedlings on milacre plots after the first, second, third, and seventh growing seasons.

In another phase of this study, branches bearing serotinous cones of three age classes (1 to 2, 3 to 9, and 10+ years old) were placed on the ground and at 1-, 2-, and 3-foot heights above the ground on north and on south aspects (fig. 1). In the two study areas six branches were placed at each height on both aspects; seed released from cones were caught in small wire screen baskets. To determine the effect of wire baskets on cone opening, 12 cones were placed 6 inches above square-foot seed traps on each study area--six cones in screen baskets and six without screens.

RESULTS

SLASH DISPOSAL METHODS AND SEEDLING ESTABLISHMENT

Contrary to expectations, two to three times as many seedlings per acre were established when logging slash was piled green as when it was piled after drying for a summer (table 1). On the Lewis and Clark National Forest the difference between treatments expressed in numbers of seedlings was significant at the 95-percent level of probability; the difference on the Gallatin National Forest was significant at the 93-percent level.

Table 1.--Density, stocking, and height of lodgepole pine seedlings 7 years after slash treatments

Slash condition	Langhor Creek, Gallatin N.F.			Deadhorse Creek, Lewis and Clark N.F.		
	Seedlings per acre	Stocking	Height at age 7	Seedlings per acre	Stocking	Height at age 7
	Number	Percent	Feet	Number	Percent	Feet
Green	7,067	78.3	1.6	22,175	97.5	1.6
Dry	1,967	53.3	1.1	10,475	98.8	2.0

Analysis of stocking showed no significant difference between treatments. Nor was there significant difference between treatments in average height of the tallest seedling on each stocked quadrat at age 7.

Figure 1.--Branches bearing serotinous cones placed on the ground and at 1-foot intervals above it.

SEROTINOUS CONE OPENING

Only those cones placed directly on the ground opened. No cones opened that were 1 foot or more above the ground. Of cones on the ground, 83.3 percent on the south aspect released seed, compared with only 40.5 percent on the north aspect.

Although the same percentage (17 percent) of the caged and uncaged cones placed above seedtraps opened fully, the writer believes that the wire screen baskets may have had an undetermined inhibitory effect on cone opening for the following reasons:

1. Sampling was not adequate to determine a real effect of the wire screens.

2. Cone opening is directly related to temperatures needed to melt the resin bond between the cone scales and undoubtedly the wire screens shaded the cones inside.

3. The percentages of cones that opened on both aspects appeared to be low, although soil surface temperatures in the summer commonly exceed those necessary to break cone serotiny at these elevations.[3]

No significant differences were found among three age classes of cones (1 to 2, 3 to 9, and 10+ years old) in either number of seed released or percentage of sound seed. An average of 12.3 ± 3.0 seed per cone (at 95-percent level of probability) was released, of which 50.3 percent of the seed were sound.

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[3] Data filed at Intermountain Forest and Range Experiment Station, Bozeman, Montana.

In lodgepole pine, the number of fully developed seed per cone varies widely--from one or two to 50.[4] Apparently, in central Montana a low average number of sound seed per cone can result in the establishment of a superabundance of seedlings on clear cuts--probably because of the large number of serotinous cones and the favorable environment for germination.

DISCUSSION

SLASH DISPOSAL METHODS AND SEEDLING ESTABLISHMENT

We had anticipated that piling the slash green would result in fewer cones opening to release seed. But, apparently slash in both treatments remained in place long enough for the resin bonds to melt on cones that were close to the ground. Most cones begin to open when subjected to temperatures above 113° F.[5] [6] The writer has observed cones on or near the ground beginning to open within 15 minutes after trees had been felled on a hot summer day.

Although not thoroughly tested, the following are possible explanations for anomalous results from piling slash:

1. Piling slash after it has dried for a summer destroys some seedlings that germinate from seed released either from nonserotinous cones prior to cutting or from serotinous cones that open early enough in the season to permit germination the same year. When this is done, machinery used in piling is on the area after these seedlings have germinated with the result that many are trampled. Piling slash green, however, distributes some cones on the ground without a covering of slash. Thus, exposed to high soil surface temperatures, they are more likely to open than are cones buried in dry slash. When the green slash method is used, most germination occurs the spring after piling and therefore seedlings are not subjected to destruction by machinery used in piling. The same is true for seedlings originating from nonserotinous cones.

2. It is probable that fewer seeds germinate during the first year in the dry slash treatment because scattered dry slash inhibits germination. Exposure of these seed to destructive agents (rodents, insects, fungi) for an additional year decreases the likelihood of germination the second year.

CONCLUSIONS

SLASH DISPOSAL

Neither method of slash disposal resulted in desirable seedling intensity. However, results of the dry slash treatment on Langhor Creek were nearly satisfactory. An abundant seed source in serotinous cones and favorable environmental conditions in central Montana combined to produce a superabundance of seedlings in both treatments. When this occurs, thinning is necessary to prevent stagnation and loss of growth.

SEROTINOUS CONE OPENING

The cone opening phase of this study clearly demonstrated that for serotinous cones to open they must be on or near the ground, where soil surface temperatures in summer usually exceed those required to break serotiny. If weather conditions are right, only a few days are needed to break the resin bond on a large percentage of cones.

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[4] Tackle, David. Silvics of lodgepole pine. U.S. Forest Serv. Intermountain Forest and Range Expt. Sta. Misc. Pub. 19, 24 pp., illus., rev. 1961.

[5] Clements, F. E. The life history of lodgepole pine burn forests. U.S. Forest Service Bull. 79, 56 pp., illus. 1910.

[6] Cameron, Hugh. Melting point of the bonding material in lodgepole pine and jack pine cones. Canada Dept. Resources and Devlpmt. Forestry Branch, Forest Res. Div., Silv. Lflt. 86, 3 pp. 1953.